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# BUFF-BURNING CLAY RESOURCES OF SOUTHWESTERN AND SOUTHERN ILLINOIS

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# BUFF-BURNING CLAY RESOURCES OF SOUTHWESTERN AND SOUTHERN ILLINOIS

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## ABSTRACT

Some 66 samples of Pennsylvanian clays that occur in the Spoon and Abbot Formations in Calhoun, Cass, Gallatin, Greene, Jackson, Jersey, Johnson, Madison, Monroe, Pike, St. Clair, Saline, Scott, and Williamson Counties, Illinois, were tested to determine their potential uses. Their bonding and ceramic properties were determined.

## INTRODUCTION

This report is another in a series of guides to locate new clay deposits (fig. 1) which may be used in the manufacture of china, drain tile, flower pots, flue liners, lightweight aggregate, paper, refractories, refractory cements, sewer pipe, stoneware, structural clay products (brick, hollow block, and tile), terra cotta and terra sigillata (a mixture of clay and pigments dispersed in water to be sprayed or dipped on ceramic ware), and which may be used as fillers and bonding clays. Tabulated data on the individual samples of clays tested are given in Appendix A; thickness of beds and stratigraphic sequence of clays are shown by the measured sections in Appendix B; and some supplemental references are given in Appendix C. The three previous reports on clays of this nature have been published for LaSalle (Parham, 1959), Knox (Parham, 1960), and Rock Island, Mercer, and Henry Counties (Parham, 1961).



Fig. 1 - Locations from which samples of clay were taken for ceramic tests.

## GEOLOGY

### Stratigraphy

Because most of the counties included in this report are covered by glacial deposits, exposures of the Pennsylvanian rocks are limited mainly to stream cuts, road cuts, and mines. Many of the samples reported here were taken from beds of clay that normally occur directly beneath layers of coal. Such beds of gray, fine-grained, nonbedded clay, called underclay, range in thickness from a few inches to about 20 feet. The remaining samples were from shales.

Classification of the Pennsylvanian strata of the area of this report is indicated in figure 2 (Kosanke et al., 1960). Only members that will aid in locating the samples stratigraphically are listed.

Throughout most of the area concerned in this report the Pennsylvanian rocks have a gentle regional dip. In western Illinois the rocks dip gently toward the east, but in the southern counties they have a slightly greater dip toward the north. In Saline and Gallatin Counties, however, where there has been a great deal of faulting, the direction and degree of dip of the rocks can vary greatly within short distances; nevertheless the regional dip is generally northward.

Many of the Pennsylvanian rocks, originally deposited in the Illinois Basin, now crop out near the eastern, southern, and western borders of Illinois and along a belt across the north-central portion of the state. Some of these rocks form continuous beds that extend from outcrops on one side of the Illinois Basin to the other, but in the deeper portions of the basin in south-central Illinois the same beds may be buried under several hundred feet of younger rocks.

Most of the samples of clay tested were taken from various beds of the Spoon Formation; some samples were taken from beds of uncertain stratigraphic position.

The detailed geology at each of the outcrops sampled is given in the measured geologic sections (appendix B), listed by counties arranged alphabetically. The sample numbers, location, stratigraphy, lithology, and thickness of each lithologic unit are given. The clay or shale sampled is indicated by the sample number, which is also the cross reference to the chemical data (table 1) and the tabulated ceramic tests and suggested uses (table 2).

For detailed geology of the area, see the references listed in the bibliography at the end of this report (appendix C).

### Mineralogy

The mineralogy of the clay samples was determined by x-ray, differential thermal analyses, microscopic techniques, and by visual observation. The clay minerals common to many of the samples are illite, kaolinite, mixed-layer clay minerals, and chlorite. The nonclay minerals are chiefly quartz with minor amounts of pyrite, siderite, calcite, and gypsum.

The clays and shales vary in clay mineral composition from almost pure kaolinite to almost pure mixed-layer clay material. Most of the clays, however, are mixtures of two or more clay minerals.

| System             | Group       | Formation  | Members                  |                         |
|--------------------|-------------|------------|--------------------------|-------------------------|
|                    |             |            | Monroe County and north  | south of Monroe County  |
| Pleistocene Series |             |            |                          |                         |
| Pennsylvanian      | McLeansboro | Mattoon    |                          |                         |
|                    |             | Bond       |                          |                         |
|                    |             | Modesto    |                          |                         |
|                    | Kewanee     | Carbondale | Pleasantview Ss          |                         |
|                    |             |            | Purinton Sh              |                         |
|                    |             |            | Francis Creek Sh         |                         |
|                    |             |            | Colchester (No. 2) Coal  | Colchester (No. 2) Coal |
|                    |             | Spoon      | Wiley Coal               | DeKoven Coal            |
|                    |             |            | Seahorne Ls              | Davis Coal              |
|                    |             |            |                          | Seahorne Ls             |
|                    |             |            | DeLong Coal              | Vergennes Ss            |
|                    |             |            |                          | Mt. Rorah Coal          |
|                    |             |            | Brush Coal               | Creal Springs Ls        |
| Mississippian      | McCormick   | Abbott     | Hermon Coal              | Granger Ss              |
|                    |             |            | Selville Ls              |                         |
|                    |             |            | Rock Island (No. 1) Coal | Murphysboro Coal        |
|                    |             |            |                          | Bidwell Coal            |
|                    |             |            | Bernadotte Ss            | Murray Bluff Ss         |
|                    |             |            | Pope Creek Coal          | Delwood Coal            |
|                    | Caseyville  | Abbott     | Tarter Coal              | Willis Coal             |
|                    |             |            | Manley Coal              |                         |
|                    |             |            | Babylon Ss               | Grindstaff Ss           |
|                    |             |            |                          | Reynoldsburg Coal       |
|                    |             |            |                          |                         |

Fig. 2 - Modified stratigraphic section.

Quartz and pyrite occur in various concentrations in all the clays, whereas siderite, calcite, and gypsum are less common. Gypsum usually occurs only on or near the surface of the weathered clay outcrops.

During weathering of pyrite in the clays, iron sulfate and sulfuric acid are formed. The sulfuric acid reacts with any calcite present and/or the calcium on the exchange positions of the clay minerals to form gypsum. Pyrite-bearing calcareous clays are apt to have their weathered outcrops covered with this form of gypsum. In addition, products leached from overlying coal or other lithologic units may finally form gypsum in joints in an underlying clay bed.

## REPORT OF TESTS

Information about the geology of the clay samples, their location, thickness, overburden, and type of underlying and overlying sediments, is given in Appendix B. Chemical data are given in table 1, and the results of tests for the physical and ceramic properties and the suggested uses for each sample are given in table 2. The ceramic test results include the drying and firing shrinkage, water of plasticity, fired color, and, where applicable, the bonding properties of the clay.

### Formation and Firing of Test Bars

Samples collected in Madison County and to the north were formed into test bars by hand, but those collected in St. Clair County and to the south were made with a laboratory-size extrusion machine. The extruded samples are marked with an asterisk in table 2. The clay used for the hand-molded samples was ground to a powder in a disc grinder. Clays ground to  $\frac{1}{4}$ -inch in diameter and less were used for extruded test bars. The percentage of water necessary to hand form or extrude a satisfactory test bar is listed as water of plasticity. More water is needed in hand forming test bars and, as a result, water of plasticity and drying and total shrinkage values for any given clay are higher for hand-molded than for extruded test bars. Both methods were used for the preparation of test bars from a selected clay and a selected shale for comparison of results. Table 3 illustrates the variations in values obtained with the two techniques.

Three individual test bars were made from each sample of clay. The bars were measured after drying to determine the percentage of drying shrinkage. The first bar was fired to 1832°F. (1000 °C.), the second 2012° F.(1100° C.), and the third to 2200° F. (1205°C.). The test bars were measured after each firing to determine the percentage of firing shrinkage. The method of preparing the test bar, hand molding vs. extrusion, has little effect on the fired properties of a clay.

Those clays listed as having "good" extrusion properties are those that give sharp, even edges on the test bar during extrusion. Clays that show some tearing of the edges of the test bar during extrusion are considered as having "fair" extrusion properties, and those that show considerable tearing are listed as having "poor" extrusion properties.

Pyrite, which is normally disseminated throughout the clay, will oxidize during weathering to form ferrous sulfate. The latter will, in turn, alter to limonite and sulfuric acid as weathering continues. The formation of iron sulfate and iron oxide tend to give the fired clay a dark color. For a better indication of the true ceramic properties and burning color, it would be necessary to obtain unweathered samples of the clay from drill holes in the area under consideration but at some distance from the outcrops.

If soluble salts are present in a clay, they will migrate outward to the surface of an unfired brick during the drying period. If ferrous sulfate is the soluble salt, the fired color is generally dark brick red, but if calcium sulfate is the soluble salt, a white scum forms on the surface during firing.

### High-Temperature Properties

On the basis of mineralogical data, samples with the largest amounts of kaolinite were selected for tests to determine their fusion temperature P.C.E. (pyrometric cone equivalent).

Refractories are classified in the following manner (American Society of Testing Materials, 1958):

|                  | Minimum P.C.E. |
|------------------|----------------|
| Super duty       | 33             |
| High heat duty   | 31             |
| Medium heat duty | 29             |
| Low heat duty    | 15             |

One Clay (996N) from Pike County can be assigned to the super duty heat class. Clays sampled in Madison, Jersey, Greene, Scott, and Calhoun Counties could be used for medium heat duty refractories; samples 1719 in St. Clair, 1806 in Jackson, 1809 in Gallatin, and 1813, 1814, and 1818 in Saline Counties would be most suitable for low heat duty refractories.

### Bonding Tests

Some underclays have been found to be satisfactory for use as bonding clays for foundry sands. The clay mineralogy of an underclay may be used to predict its bonding properties. Clays that have poorly crystalline kaolinite and those that have large amounts of mixed-layer clay minerals are better bonding clays than the more crystalline clay mineral varieties.

Mixtures of 92 percent foundry sand and 8 percent clay were made and mixed with varying amounts of water. Bonding tests were then run in a manner described in the "Foundry Sand Handbook" (American Foundrymen's Society, 1952). The green compression strength of each sample tested, in pounds per square inch (GCS psi), is listed in table 1 under bonding properties. The maximum green strength is that strength developed by the clay at its optimum water content. Samples 958H and 958Z from Greene County, 393, 960C, and 960F from Madison County, and 1803 from Williamson County gave favorable green strengths in the bonding tests.

### SUMMARY AND CONCLUSIONS

The clays and shales tested in this report may serve as raw materials for a wide variety of uses. Clays or shales can be mixed to enhance or develop certain desired properties or to minimize undesirable characteristics. For instance, a wide variation in fired color can be obtained in a product by the mixing of light and dark firing clays in varying proportions. Plasticity, drying shrinkage, firing shrinkage, and refractoriness also can be varied by the mixing process.



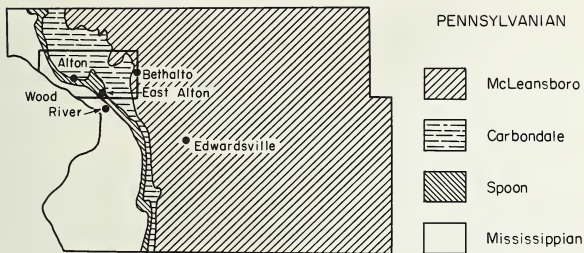


Fig. 3 - Generalized bedrock geology of Madison County and location of fig. 4.

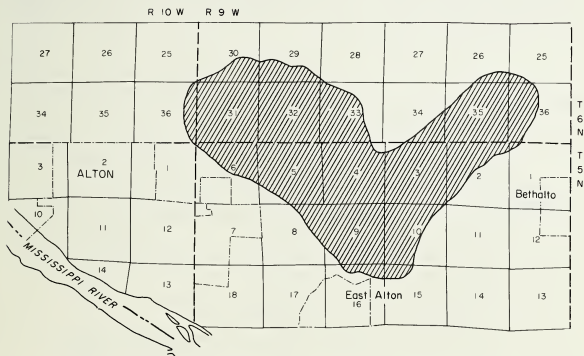


Fig. 4 - Location of samples studied and suggested area for prospecting for strippable clay resources.

The tables of this report may serve as a general guide to predict the properties, uses, and values of combined samples. However, the actual commercial value of a sample or combination of samples is dependent not only upon the qualities listed in the table but also upon a complex of factors involving local geologic, geographic, and economic conditions at the site of the deposit.

In Madison County, because outcrops below the Colchester No. 2 Coal are rare, sampling was limited to two locations. However, the outcrop areas of sediments above the coal and below the clay suggest an area (figs. 3 and 4) in which the overburden may be thin enough to permit mining the clay by stripping operations. Core drilling will be necessary to reveal the thickness of the overburden, thickness of the clay, and quality of the clay.

Sample 996N from Pike County, compared with other samples, is unusual in its measured physical properties. It is composed primarily of the clay mineral kaolinite, which gives the fired clay a white color. Because of its high kaolinite content it is the only sample with a P.C.E. high enough (P.C.E. 33) to be assigned to the super heat duty refractory class and may have some potential for use in the china or paper industries.

Samples taken from Scott County south to Madison County could be used for medium heat duty refractories. A few samples in the counties studied to the south and east can be classed in the low heat duty class.

Samples 958H and 958Z in Greene County and all of the samples of Madison County produced satisfactory green strength in the bonding tests. This group of samples is of the poorly crystalline kaolinite variety and, therefore, would be more refractory. Samples 954D of Cass County and 1803 of Williamson County have good bonding strength but are rich in the mixed-layer clay mineral component and, therefore, are less refractory.

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#### REFERENCES

- American Foundrymen's Society, 1952, Foundry sand handbook: 6th ed., p. 17-28, 85-89, 93-95.
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- Kosanke, R. M., Simon, J. A., Wanless, H. R., and Willman, H. B., 1960, Classification of the Pennsylvanian strata of Illinois: Illinois Geol. Survey Rept. Inv. 214, 84 p.
- Parham, W. E., 1959, Light-burning clay resources in LaSalle County, Illinois: Illinois Geol. Survey Circ. 277, 27 p.
- Parham, W. E., 1960, Lower Pennsylvanian clay resources of Knox County, Illinois: Illinois Geol. Survey Circ. 302, 19 p.
- Parham, W. E., 1961, Lower Pennsylvanian clay resources of Rock Island, Mercer, and Henry Counties, Illinois: Illinois Geol. Survey Circ. 322, 40 p.

TABLE 1 - CHEMICAL ANALYSES AND DATA

| Sample 393                     |         | Sample 996N                    |         |
|--------------------------------|---------|--------------------------------|---------|
| Oxide                          | Percent | Oxide                          | Percent |
| SiO <sub>2</sub>               | 56.92   | SiO <sub>2</sub>               | 53.11   |
| TiO <sub>2</sub>               | 1.40    | TiO <sub>2</sub>               | 1.98    |
| Al <sub>2</sub> O <sub>3</sub> | 26.80   | Al <sub>2</sub> O <sub>3</sub> | 32.39   |
| Fe <sub>2</sub> O <sub>3</sub> | 2.51    | Fe <sub>2</sub> O <sub>3</sub> | 0.36    |
| FeO                            | 0.35    | FeO                            | 0.09    |
| MgO                            | 0.51    | MgO                            | 0.30    |
| CaO                            | 0.17    | CaO                            | 0.13    |
| Na <sub>2</sub> O              | 0.50    | Na <sub>2</sub> O              | 0.28    |
| K <sub>2</sub> O               | 0.48    | K <sub>2</sub> O               | 0.29    |
| Ign.                           | 10.41   | Ign.                           | 11.49   |
| Total                          | 100.05  | Total                          | 100.42  |
| H <sub>2</sub> O-              | 2.06    | H <sub>2</sub> O-              | 0.84    |
| P <sub>2</sub> O <sub>5</sub>  | trace   | P <sub>2</sub> O <sub>5</sub>  | trace   |
| SO <sub>2</sub>                | 0.00    | SO <sub>2</sub>                | 0.00    |

Exchangeable cations (Sample 393):

|                  |                 |                              |                 |
|------------------|-----------------|------------------------------|-----------------|
| Al <sup>+3</sup> | 0.00 me/100 gm. | Na <sup>+</sup>              | 9.07 me/100 gm. |
| Fe <sup>+3</sup> | 0.00            | K <sup>+</sup>               | 0.75            |
| Mg <sup>++</sup> | 3.85            | SO <sub>4</sub> <sup>=</sup> | 1.25            |
| Ca <sup>++</sup> | 5.35            |                              |                 |

Cation exchange capacity 17.5 me/100 gm.; pH 8.1

TABLE 3 - COMPARISON OF DATA FOR HAND-MOLDED AND EXTRUDED SAMPLES

|                         | Clay   |          | Shale  |          |
|-------------------------|--------|----------|--------|----------|
|                         | Molded | Extruded | Molded | Extruded |
| Water of plasticity     | 24.5   | 18.0     | 21.5   | 19.0     |
| Linear drying shrinkage | 6.25   | 4.68     | 4.17   | 2.34     |
| Linear firing shrinkage |        |          |        |          |
| 1832°                   | 1.04   | 1.05     | 2.08   | 4.95     |
| 1922°                   |        | 2.09     | 6.25   | 6.51     |
| 2012°                   | 4.17   | 3.13     | 8.33   | 8.64     |
| Total firing shrinkage  |        |          |        |          |
| 1832°                   | 7.29   | 5.73     | 6.25   | 7.29     |
| 1922°                   |        | 6.77     | 10.42  | 8.85     |
| 2012°                   | 10.42  | 7.81     | 12.50  | 10.98    |

TABLE 2 - CERAMIC AND OTHER DATA

| Sample no.      | Thickness | Extrusion properties and workability | Water of plasticity (%) | Linear drying shrinkage (%) | Firing temperatures in degrees Fahrenheit |       |       |                            |       |       |             |        |        | Bonding properties |                     |
|-----------------|-----------|--------------------------------------|-------------------------|-----------------------------|-------------------------------------------|-------|-------|----------------------------|-------|-------|-------------|--------|--------|--------------------|---------------------|
|                 |           |                                      |                         |                             | Linear firing shrinkage (%)               |       |       | Total linear shrinkage (%) |       |       | Fired color |        |        | GCS                | Opt.**              |
|                 |           |                                      |                         |                             | 1832°                                     | 2012° | 2200° | 1832°                      | 2012° | 2200° | 1832°       | 2012°  | 2200°  | (psi)              | H <sub>2</sub> O(%) |
| Calhoun County  |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                     |
| 1067B           | 3' 6"     | sticky                               | 36.6                    | 10.4                        | 2.1                                       | 3.1   | 5.2   | 12.5                       | 13.5  | 15.6  | Buff        | Buff   | Buff   |                    |                     |
| 1067D           | 2'        | good                                 | 21.4                    | 5.2                         | 1.0                                       | 8.3   | 5.2   | 6.2                        | 13.5  | 10.4  | Buff        | Buff   | Gray   |                    |                     |
| Cass County     |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                     |
| 994D            | 2' 1"     | good                                 | 54.3                    | 16.7                        | 8.3                                       | —     | —     | 25.0                       | —     | —     | Salmon      |        |        |                    |                     |
| 994C            | 5' 3"     | good                                 | 36.8                    | 10.4                        | 2.1                                       | 6.3   | 8.3   | 12.5                       | 16.7  | 18.7  | Buff        | Buff   | Brown  |                    |                     |
| 994B            | 2' 9"     | good                                 | 26.6                    | 6.3                         | 1.0                                       | 7.3   | 5.2   | 7.3                        | 13.6  | 11.5  | Salmon      | Salmon | Salmon |                    |                     |
| Gallatin County |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                     |
| 1809            | 5'        | fair*                                | 22.0                    | 4.5                         | 1.1                                       | 2.7   | 3.8   | 5.6                        | 7.2   | 8.3   | Pink        | Salmon | Tan    |                    |                     |
| 1810            | 2'        | fair*                                | 23.0                    | 3.5                         | 4.3                                       | 6.7   | 6.3   | 7.8                        | 10.2  | 9.8   | Salmon      | Tan    | Tan    |                    |                     |
| Greene County   |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                     |
| 958F            | 1'        | good                                 | 33.8                    | 9.4                         | 2.3                                       | 2.3   | 6.2   | 11.7                       | 11.7  | 15.6  | Pink        | Buff   | Buff   | 6.2                | 1.5                 |
| 958H            | 4'        | good                                 | 36.4                    | 10.9                        | +3.9                                      | 4.7   | 5.8   | 7.0                        | 15.6  | 16.7  | Pink        | Buff   | Buff   | 8.0                | 1.9                 |
| 958K            | 1'        | good                                 | 23.8                    | 8.6                         | 0.7                                       | 1.8   | 2.9   | 9.3                        | 10.4  | 11.5  | Pink        | Buff   | Buff   | 6.5                | 1.3                 |
| 958U            | 6'        | good                                 | 20.8                    | 5.5                         | 0.0                                       | 0.0   | 2.3   | 5.5                        | 5.5   | 7.8   | Buff        | Buff   | Buff   |                    |                     |
| 958W            | 3½'       | good                                 | 23.4                    | 7.8                         | 2.3                                       | 4.7   | 7.8   | 10.1                       | 12.5  | 15.6  | Pink        | Buff   | Buff   |                    |                     |
| 958X            | 5'        | good                                 | 24.6                    | 6.3                         | 3.1                                       | 5.2   | 7.3   | 9.4                        | 11.5  | 13.6  | Pink        | Buff   | Buff   |                    |                     |
| 958Y            | 5'        | good                                 | 22.0                    | 4.7                         | 1.6                                       | 2.6   | 3.6   | 6.3                        | 7.3   | 8.3   | Pink        | Buff   | Buff   |                    |                     |
| 958Z            | 6'        | good                                 | 26.6                    | 7.8                         | 3.1                                       | 4.2   | 6.8   | 10.9                       | 12.0  | 14.6  | Pink        | Buff   | Buff   | 9.2                | 1.4                 |
| 958V            | 5'        | good                                 | 21.5                    | 3.9                         | 2.4                                       | 8.3   | 9.6   | 6.3                        | 12.2  | 13.5  | Pink        | Buff   | Buff   |                    |                     |
| 958BB           | 2'        | good                                 | 36.7                    | 10.9                        | 2.4                                       | 4.7   | 5.9   | 13.3                       | 15.6  | 16.8  | Pink        | Buff   | Buff   | 6.4                | 1.3                 |
| 958VV           | 2'        | good                                 | 22.2                    | 5.5                         | +0.8                                      | 2.8   | 4.9   | 4.7                        | 8.3   | 10.4  | Pink        | Buff   | Buff   |                    |                     |
| 958FFF          | 5'        | good                                 | 31.3                    | 9.4                         | 3.1                                       | 5.2   | 6.2   | 12.5                       | 14.6  | 15.6  | Pink        | Buff   | Buff   |                    |                     |
| 955             | 6'        | good                                 | —                       | 5.5                         | 0.8                                       | 3.9   | 7.0   | 6.3                        | 9.4   | 12.5  | Pink        | Buff   | Buff   |                    |                     |
| 956             | 5'        | good                                 | 24.0                    | 6.3                         | 1.5                                       | 2.7   | 5.4   | 7.8                        | 9.0   | 11.7  | Pink        | Buff   | Buff   |                    |                     |
| 957             | 5'        | good                                 | 26.0                    | 7.0                         | 0.8                                       | 1.6   | 4.7   | 7.8                        | 8.6   | 11.7  | Pink        | Buff   | Buff   | 5.7                | 1.3                 |
| Jackson County  |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                     |
| 1800            | 3'        | good*                                | 18.1                    | 4.7                         | 1.5                                       | 3.6   | 5.0   | 6.2                        | 8.3   | 9.7   | Buff        | Salmon | Tan    |                    |                     |
| 1801            | 1'–3'     | fair*                                | 22.3                    | 5.0                         | 2.7                                       | 6.0   | 6.7   | 7.7                        | 11.0  | 11.7  | Buff        | Salmon | Tan    |                    |                     |
| 1806            | 3'        | good*                                | 14.0                    | 2.5                         | 0.8                                       | 3.3   | 5.0   | 3.3                        | 5.8   | 7.5   | Buff        | Buff   | Buff   |                    |                     |
| Jersey County   |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                     |
| 959E            | 7'        | good                                 | 26.9                    | 7.0                         | 1.6                                       | 3.4   | —     | 8.6                        | 10.4  | —     | Buff        | Buff   |        | 3.8                | 1.3                 |
| 959F            | 5½'       | good                                 | 26.5                    | 7.8                         | 2.4                                       | 4.7   | 4.7   | 10.2                       | 12.5  | 12.5  | Buff        | Buff   | Buff   | 6.8                | 2.4                 |
| 959G            | 2½'       | good                                 | 23.5                    | 4.0                         | 0.7                                       | 8.0   | 8.5   | 4.7                        | 12.0  | 12.5  | Buff        | Buff   | Buff   | 7.8                | 1.4                 |
| Johnson County  |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                     |
| 1807            | 2½'       | poor*                                | 22.8                    | 3.8                         | 1.4                                       | 6.4   | 6.9   | 5.2                        | 10.2  | 10.7  | Buff        | Salmon | Tan    |                    |                     |
| Madison County  |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                     |
| 393             | 6'        | good<br>good but stiff               | 31.6                    | 8.9                         | 0.5                                       | 3.6   | 4.6   | 9.4                        | 12.5  | 13.5  | Cream       | Cream  | Gray   | 11.5               | 1.8                 |
| 960C            | 1' 3"     | stiff                                | 35.0                    | 9.4                         | 1.0                                       | 6.2   | 6.2   | 10.4                       | 15.6  | 15.6  | Buff        | Buff   | Buff   | 10.0               | 1.4                 |
| 960D            | 1' 3"     | good                                 | 31.6                    | 9.4                         | 1.0                                       | 5.2   | 6.2   | 10.4                       | 14.6  | 15.6  | Gray        | Buff   | Buff   | 9.2                | 1.7                 |
| 960E            | 3'        | good                                 | 30.8                    | 8.3                         | 1.6                                       | 6.3   | 7.3   | 9.9                        | 14.6  | 15.6  | Buff        | Buff   | Buff   | 10.4               | 1.7                 |
| 960F            | 3'        | good<br>but stiff                    | 27.8                    | 7.8                         | 0.5                                       | 6.8   | 7.8   | 8.3                        | 14.6  | 15.6  | Buff        | Buff   | Buff   | 9.5                | 1.4                 |

## OF CLAY MATERIALS AND THEIR USES

| Sample no.      | Suggested Uses |            |         |             |             |                        |       |         |                             |            |           |                          |             | Remarks<br>ox = oxidation<br>gd = good<br>drcd = drying conduct<br>diff = difficult |                 |                                                                                              |
|-----------------|----------------|------------|---------|-------------|-------------|------------------------|-------|---------|-----------------------------|------------|-----------|--------------------------|-------------|-------------------------------------------------------------------------------------|-----------------|----------------------------------------------------------------------------------------------|
|                 | China          | Drain tile | Fillers | Flower pots | Flue liners | Light weight aggregate | Paper | Pottery | Refractories & ref. cements | Sewer pipe | Stoneware | Structural clay products | Terra cotta |                                                                                     | Terra sigillata | Bonding clay                                                                                 |
| Calhoun County  |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                                                                                     |                 |                                                                                              |
| 1067B           |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; too much water added to clay mix                                                     |
| 1067D           |                |            |         | X           | X           |                        |       | X       |                             | X          | X         | X                        |             |                                                                                     |                 | ox, gd; overfired at 2200°F.                                                                 |
| Cass County     |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                                                                                     |                 |                                                                                              |
| 994D            |                |            |         |             |             |                        |       |         |                             |            |           |                          |             | X                                                                                   |                 | ox, gd; drcd, warped and cracked.                                                            |
| 994C            |                |            |         | X           |             |                        |       | X       |                             | X          | X         |                          |             |                                                                                     |                 | ox, gd; drcd, fair.                                                                          |
| 994B            |                | X          |         | X           |             |                        |       | X       |                             |            |           | X                        |             |                                                                                     |                 | ox, gd; drcd, gd; overfired at 2200°F.                                                       |
| Gallatin County |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                                                                                     |                 |                                                                                              |
| 1809            |                | X          |         | X           |             |                        |       | X       |                             | X          |           | X                        |             |                                                                                     |                 | Surface scum at 1832 and 2012°F.                                                             |
| 1810            |                | X          |         | X           |             |                        |       | X       |                             |            |           | X                        |             |                                                                                     |                 | Surface scum at 1832 and 2012°F; slightly rough edges during extrusion; overfired at 2200°F. |
| Greene County   |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                                                                                     |                 |                                                                                              |
| 958F            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd gd; weathered clay shows ferrous sulfate scumming.                              |
| 958H            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             | X                                                                                   |                 | ox, gd; drcd, gd.                                                                            |
| 958K            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 958U            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 958W            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 958X            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 958Y            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 958Z            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             | X                                                                                   |                 | ox, gd; drcd, gd.                                                                            |
| 958V            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 958BB           |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 958VV           |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 958FFF          |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 955             |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 956             |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 957             |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                                                                                     |                 |                                                                                              |
| Jackson County  |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                                                                                     |                 |                                                                                              |
| 1800            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                                                                                     |                 | Normal                                                                                       |
| 1801            |                | X          |         | X           | X           |                        |       |         |                             | X          |           | X                        |             |                                                                                     |                 | Surface scum at 1832° and 2012; some tearing during extrusion                                |
| 1806            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                                                                                     |                 | Some tearing during extrusion                                                                |
| Jersey County   |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                                                                                     |                 |                                                                                              |
| 959E            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 959F            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| 959G            |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     |                 | ox, gd; drcd, gd.                                                                            |
| Johnson County  |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                                                                                     |                 |                                                                                              |
| 1807            |                | X          |         | X           |             |                        |       |         |                             |            |           | X                        |             |                                                                                     |                 | Surface scum at 2012°; tends to tear during extrusion.                                       |
| Madison County  |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                                                                                     |                 |                                                                                              |
| 393             |                | X          | X       | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             | X                                                                                   | X               | ox, gd; drcd, gd. Chemical data in table 4.                                                  |
| 960C            |                |            |         |             | X           |                        |       | X       | X                           | X          | X         | X                        |             |                                                                                     | X               | ox, diff; drcd, gd.                                                                          |
| 960D            |                |            | X       |             | X           |                        |       | X       | X                           | X          | X         | X                        |             | X                                                                                   | X               | ox, diff; drcd, gd.                                                                          |
| 960E            |                |            | X       |             | X           |                        |       | X       | X                           | X          | X         | X                        |             | X                                                                                   | X               | ox might be diff; drcd, gd.                                                                  |
| 960F            |                |            | X       |             | X           |                        |       | X       | X                           | X          | X         | X                        |             | X                                                                                   | X               | ox, gd; drcd, gd.                                                                            |

TABLE 2

| Sample no.        | Thickness | Extrusion properties and workability | Water of plasticity (%) | Linear drying shrinkage (%) | Firing temperatures in degrees Fahrenheit |       |       |                            |       |       |             |        |        | Bonding properties |                            |
|-------------------|-----------|--------------------------------------|-------------------------|-----------------------------|-------------------------------------------|-------|-------|----------------------------|-------|-------|-------------|--------|--------|--------------------|----------------------------|
|                   |           |                                      |                         |                             | Linear firing shrinkage (%)               |       |       | Total linear shrinkage (%) |       |       | Fired color |        |        | GCS (psi)          | Opt.** H <sub>2</sub> O(%) |
|                   |           |                                      |                         |                             | 1832°                                     | 2012° | 2200° | 1832°                      | 2012° | 2200° | 1832°       | 2012°  | 2200°  |                    |                            |
| Monroe County     |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                            |
| 1797              | 5'        | good*                                | 22.6                    | 7.2                         | 4.3                                       | 5.0   | 3.0   | 11.5                       | 12.2  | 10.2  | Red         | Red    | Brown  | 6.4                | 2.0                        |
| 1798              | 3' 4"     | fair*                                | 17.6                    | 4.5                         | 2.3                                       | 6.0   | 4.1   | 6.8                        | 10.5  | 8.6   | Red         | Red    | Red    | 4.8                | 1.5                        |
| 1799              | 3' 3"     | good*                                | 18.6                    | 5.5                         | 1.3                                       | 4.7   | 5.2   | 6.8                        | 10.2  | 10.7  | Red         | Red    | Red    | 4.3                | 1.7                        |
| Pike County       |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                            |
| G17               | 2'        | good                                 | 26.7                    | 5.9                         | 1.4                                       | 0.9   | 1.4   | 7.3                        | 6.8   | 7.3   | Cream       | Cream  | Buff   |                    |                            |
| G18               | 1'        | good                                 | 29.8                    | 6.3                         | 1.0                                       | 4.1   | 7.2   | 7.3                        | 10.4  | 13.5  | Cream       | Cream  | Cream  |                    |                            |
| G19               | 2' 6"     | good                                 | 26.5                    | 5.2                         | 1.6                                       | 2.1   | 5.2   | 6.8                        | 7.3   | 10.4  | Pink        | Pink   | Tan    |                    |                            |
| G20               | 3' 2"     | good                                 | 20.8                    | 5.2                         | 2.1                                       | 6.3   | 8.9   | 7.3                        | 11.5  | 14.1  | Pink        | Buff   | Tan    |                    |                            |
| 996E              | 4' 6"     | poor                                 | 23.0                    | 5.2                         | 0.0                                       | 2.1   | 3.1   | 5.2                        | 7.3   | 8.3   | Cream       | Cream  | Cream  |                    |                            |
| 996D              | 5'        | good                                 | 57.4                    | 12.5                        | 3.1                                       | 7.3   | 12.5  | 15.6                       | 19.8  | 25.0  | Cream       | Cream  | Tan    |                    |                            |
| 996B-C            |           | good                                 | 30.0                    | 6.3                         | +1.1                                      | 4.1   | 7.2   | 5.2                        | 10.4  | 13.5  | Cream       | Cream  | Tan    |                    |                            |
| 996N              | 8'        | good                                 | 46.0                    | 12.5                        | 2.1                                       | 2.1   | 11.5  | 14.6                       | 14.6  | 24.0  | White       | White  | White  |                    |                            |
| 996F              | 6'        | good                                 | 29.5                    | 7.3                         | 2.1                                       | 5.2   | 8.3   | 9.4                        | 12.5  | 15.6  | Cream       | Cream  | Tan    |                    |                            |
| St. Clair County  |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                            |
| 1719              | 3'        | good*                                | 23.9                    | 8.5                         | 0.1                                       | 0.9   | 1.5   | 8.6                        | 9.4   | 10.0  | Salmon      | Salmon | Salmon | 3.8                | 1.3                        |
| Saline County     |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                            |
| 1804              | 5'        | fair*                                | 11.4                    | 4.7                         | 1.8                                       | 5.0   | 5.3   | 6.5                        | 9.7   | 10.0  | Salmon      | Red    | Tan    |                    |                            |
| 1805              | 3'        | good*                                | 23.0                    | 6.0                         | 5.3                                       | 5.6   | +12.2 | 11.3                       | 11.6  | +6.2  | Salmon      | Red    | Tan    |                    |                            |
| 1808              | 3'        | good*                                | 18.7                    | 6.0                         | 1.3                                       | 3.7   | 4.2   | 7.3                        | 9.7   | 10.2  | Buff        | Buff   | Buff   | 5.5                | 1.8                        |
| 1811              | 2' 4"     | poor*                                | 18.9                    | 3.0                         | 0.6                                       | 4.4   | 6.0   | 3.6                        | 7.4   | 9.0   | Buff        | Tan    | Buff   |                    |                            |
| 1812              | 3'        | fair*                                | 14.0                    | 4.5                         | 1.3                                       | 2.9   | 2.3   | 5.8                        | 7.4   | 6.8   | Cream       | Buff   | Buff   |                    |                            |
| 1813              | 6'        | good*                                | 18.4                    | 5.0                         | 1.6                                       | 2.4   | 4.1   | 6.6                        | 7.4   | 9.1   | Cream       | Buff   | Buff   |                    |                            |
| 1814              | 3'        | good*                                | 14.1                    | 4.0                         | 1.6                                       | 2.9   | 3.5   | 5.6                        | 6.9   | 7.5   | Pink        | Buff   | Cream  | 3.4                | 1.3                        |
| 1815              | 3'        | good*                                | 22.0                    | 6.0                         | 3.8                                       | 5.7   | +0.8  | 9.8                        | 11.7  | 5.2   | Salmon      | Red    | Red    | 6.6                | 1.3                        |
| 1816              | 3' 6"     | fair*                                | 20.0                    | 4.5                         | 1.3                                       | 5.2   | 6.5   | 5.8                        | 9.7   | 11.0  | Salmon      | Red    | Brown  |                    |                            |
| 1817              | 2' 8"     | good*                                | 20.0                    | 4.0                         | 1.0                                       | 5.7   | 5.1   | 5.0                        | 9.7   | 9.1   | Salmon      | Salmon | Buff   |                    |                            |
| 1821              | 8'        | fair*                                | 17.6                    | 4.0                         | 4.5                                       | 7.3   | 6.0   | 8.5                        | 11.3  | 10.0  | Red         | Red    | Brown  |                    |                            |
| Scott County      |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                            |
| 995A              | 6'        | good                                 | 35.3                    | 8.3                         | 3.2                                       | 6.3   | 11.5  | 11.5                       | 14.6  | 19.8  | Buff        | Buff   | Buff   |                    |                            |
| 995B              | 8'        | good                                 | 49.9                    | 12.5                        | 4.2                                       | 9.4   | 11.5  | 16.7                       | 21.9  | 24.0  | Buff        | Buff   | Tan    |                    |                            |
| 995H              | 4' 8"     | good                                 | 40.2                    | 10.4                        | 2.1                                       | 6.3   | 8.4   | 12.5                       | 16.7  | 18.8  | Buff        | Buff   | Buff   |                    |                            |
| Williamson County |           |                                      |                         |                             |                                           |       |       |                            |       |       |             |        |        |                    |                            |
| 1802              | 5'        | good*                                | 19.3                    | 4.5                         | 1.9                                       | 5.0   | 5.7   | 6.4                        | 9.5   | 10.2  | Pink        | Buff   | Tan    | 5.1                | 2.0                        |
| 1803              | 3'        | fair*                                | 25.0                    | 5.3                         | 4.7                                       | 8.3   | 3.2   | 10.0                       | 13.6  | 8.5   | Salmon      | Red    | Red    | 8.4                | 1.8                        |
| 1818              | 3'        | fair*                                | 21.0                    | 5.0                         | 1.3                                       | 3.7   | 4.1   | 6.3                        | 8.7   | 9.1   | Cream       | Buff   | Buff   |                    |                            |
| 1819              | 5' 6"     | good*                                | 21.5                    | 5.5                         | 4.3                                       | 6.7   | 5.2   | 9.8                        | 12.2  | 10.7  | Red         | Red    | Red    | 6.7                | 2.0                        |
| 1820              | 4'        | fair*                                | 27.8                    | 4.0                         | 1.8                                       | 7.4   | 6.7   | 5.8                        | 11.4  | 10.7  | Red         | Red    | Red    |                    |                            |

\* Extruded sample

\*\* Optimum water content for maximum strength

- continued

| Sample no.        | Suggested Uses |            |         |             |             |                        |       |         |                             |            |           |                          |             |                 | Remarks<br>ox = oxidation<br>gd = good<br>drcd = drying conduct<br>diff = difficult |                                                                                             |
|-------------------|----------------|------------|---------|-------------|-------------|------------------------|-------|---------|-----------------------------|------------|-----------|--------------------------|-------------|-----------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
|                   | China          | Drain tile | Fillers | Flower pots | Flue liners | Light weight aggregate | Paper | Pottery | Refractories & ref. cements | Sewer pipe | Stoneware | Structural clay products | Terra cotta | Terra sigillata |                                                                                     | Bonding clay                                                                                |
| Monroe County     |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                 |                                                                                     |                                                                                             |
| 1797              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Overfired at 2200°F.                                                                        |
| 1798              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Overfired at 2200°F.                                                                        |
| 1799              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Overfired at 2200°F.                                                                        |
| Pike County       |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                 |                                                                                     |                                                                                             |
| G17               |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                 |                                                                                     | ox, gd; drcd, gd.                                                                           |
| G18               |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           | X               |                                                                                     | ox, gd; drcd, gd.                                                                           |
| G19               |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           | X               |                                                                                     | ox, gd; drcd, gd.                                                                           |
| G20               |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                 |                                                                                     | ox, gd; drcd, gd; Samples G18 through G20 can be mined together                             |
| 996E              |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                 |                                                                                     | ox, gd; drcd, gd; would have to be worked with 996D in order to have sufficient plasticity. |
| 996D              |                | X          | X       | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             | X               |                                                                                     | drcd, poor; should be worked with 996E to reduce shrinkage                                  |
| 996B & C          |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             | X               |                                                                                     | ox, gd; drcd, gd.                                                                           |
| 996N              | X              |            | X       |             |             |                        | X?    | X       | X                           |            | X         |                          |             | X               |                                                                                     | ox, gd; drcd, gd. Chemical data in table 5.                                                 |
| 996F              |                |            | X       |             | X           |                        |       | X       | X                           | X          | X         | X                        |             | X               |                                                                                     | ox, gd; drcd, gd.                                                                           |
| St. Clair County  |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                 |                                                                                     |                                                                                             |
| 1719              |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        |             |                 |                                                                                     | Iron sulfate scumming showed at 1832 and 2012°F.                                            |
| Saline County     |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                 |                                                                                     |                                                                                             |
| 1804              |                | X          |         | X           |             |                        |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Surface scum at 1832 and 2012°F for weathered clays; tends to tear during extrusion.        |
| 1805              |                | X          |         | X           |             |                        |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Surface scum at 1832 and 2012°F for weathered clays. Overfired at 2200°F.                   |
| 1808              |                | X          |         | X           |             |                        |       | X       |                             | X          | X         | X                        | X           |                 |                                                                                     | Overfired at 2200°F.                                                                        |
| 1811              |                | X          |         | X           |             |                        |       | X       |                             | X          | X         | X                        | X           | X               |                                                                                     | Normal.                                                                                     |
| 1812              |                | X          |         | X           |             |                        |       | X       |                             | X          | X         | X                        | X           |                 |                                                                                     | Overfired at 2200°F.                                                                        |
| 1813              |                | X          |         | X           |             |                        |       | X       | X                           | X          | X         | X                        | X           |                 |                                                                                     | Overfired at 2200°F.                                                                        |
| 1814              |                | X          |         | X           |             |                        |       | X       | X                           | X          | X         | X                        | X           |                 |                                                                                     | Normal.                                                                                     |
| 1815              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Surface scums at 2012°F; overfired at 2200°F.                                               |
| 1816              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Surface scum at 1832 and 2012°F for weathered clay; tends to tear when extruded.            |
| 1817              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Overfired at 2200°F.                                                                        |
| 1821              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Overfired at 2200°F. Tends to tear when extruded.                                           |
| Scott County      |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                 |                                                                                     |                                                                                             |
| 995A              |                |            | X       |             |             |                        |       | X       | X                           | X          |           |                          |             |                 |                                                                                     | ox, gd; drcd, tending to crack.                                                             |
| 995B              |                |            | X       |             |             |                        |       | X       | X                           | X          |           |                          |             |                 |                                                                                     | ox, gd; drcd, gd.                                                                           |
| 995H              |                |            | X       |             |             |                        |       | X       | X                           | X          | X         | X                        |             |                 |                                                                                     | ox, gd; drcd, gd.                                                                           |
| Williamson County |                |            |         |             |             |                        |       |         |                             |            |           |                          |             |                 |                                                                                     |                                                                                             |
| 1802              |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           |                 |                                                                                     | Normal.                                                                                     |
| 1803              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 | X                                                                                   | Overfired at 2200°F.                                                                        |
| 1818              |                | X          |         | X           | X           |                        |       | X       | X                           | X          | X         | X                        | X           | X               |                                                                                     | Normal.                                                                                     |
| 1819              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Surface scum at 1832 and 2012°F; overfired at 2200°F.                                       |
| 1820              |                | X          |         | X           |             | X                      |       | X       |                             | X          |           | X                        |             |                 |                                                                                     | Overfired at 2200°F.                                                                        |

## DESCRIPTION OF DEPOSITS SAMPLED

|                                                                                                                                        | Thickness<br>(Ft. In.) |                                                                                                  | Thickness<br>(Ft. In.) |
|----------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------------------------|------------------------|
| CALHOUN COUNTY                                                                                                                         |                        |                                                                                                  |                        |
| Sample 1067B - SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 26, T. 13 S., R. 2 W.                                           |                        | Shale, black, soft, micaceous, poorly bedded, fossiliferous                                      | 2 2                    |
| Pleistocene Series                                                                                                                     |                        | Limestone, blue-gray weathering to grayish brown, hard, fine-grained, fossiliferous              | 3-4                    |
| Loess                                                                                                                                  | 50±                    | Shale, black, fissile, hard, with pyrite concretions                                             | 18-28                  |
| Pennsylvanian System                                                                                                                   |                        | Shale (Francis Creek), gray, slightly sandy, conchoidal fracture, concretions, pyrite            | 11 8                   |
| Carbondale Formation                                                                                                                   |                        | Colchester (No. 2) Coal                                                                          | 2 9                    |
| Limestone                                                                                                                              | ?                      | Spoon Formation                                                                                  |                        |
| Shale (Purington) (?)                                                                                                                  |                        | Clay, dark gray, shaly                                                                           | 5                      |
| gray, silty                                                                                                                            | 30±                    | Clay, blue-gray, hard, shaly                                                                     | 1 2                    |
| Shale, black, clayey                                                                                                                   | 1                      | Clay, gray, very rusty with reddish weathered calcareous concretions near base, sandy            | 2 3                    |
| Colchester (No. 2) Coal                                                                                                                | 3 6                    | Clay, gray, hard, calcareous concretions, sandy                                                  | 1 9                    |
| Spoon Formation                                                                                                                        |                        | Clay, purplish gray, blocky                                                                      | 3-4                    |
| Underclay, gray, yellow-stained (sample 1067B)                                                                                         | 3                      | Wiley (?) Coal                                                                                   | 1½-3                   |
| Clay, gray (sample 1067B)                                                                                                              | 6                      | Clay, dark purplish gray, soft, blocky                                                           | 3                      |
| Clay, gray, calcareous (Seahorne Limestone zone)                                                                                       | 2                      | Clay, gray, rust brown in fractures, blocky, hard                                                | 8-18                   |
| Clay, green                                                                                                                            | 2                      | Limestone (Seahorne), blue-gray, weathering gray, nodular, bedded in clay, pyrite, fossiliferous | 2-3                    |
| Clay, gray, yellow-stained (exposed)                                                                                                   | 1                      | Clay, gray, hard, blocky (sample 994D)                                                           | 2 1½                   |
| Sample 1067D - Old clay pit along Mississippi River, center of sec. 1, T. 14 S., R. 2 W.                                               |                        | Coal                                                                                             |                        |
| Pleistocene Series                                                                                                                     |                        | Clay, gray to purplish gray, blocky (sample 994C)                                                | 3                      |
| Loess                                                                                                                                  | 10-15                  | Clay, gray, hard, blocky (sample 994C)                                                           | 2                      |
| Pennsylvanian System                                                                                                                   |                        | Covered interval                                                                                 | 3-4                    |
| Carbondale Formation                                                                                                                   |                        | Clay, gray, blocky (sample 994C)                                                                 | 1 2                    |
| Limestone, gray and tan                                                                                                                | 5                      | Clay, dark gray, shaly (coal zone) (sample 994C)                                                 | 3-6                    |
| Covered interval                                                                                                                       | 11                     | Clay, gray, shaly (sample 994C)                                                                  | 1 1                    |
| Clay, mottled red, yellow, and gray                                                                                                    | 4                      | Clay, dark gray to black, shaly (coal zone) (sample 994C)                                        | 1-2                    |
| Shale, mottled, red and green near top and gray below                                                                                  | 50                     | Clay, gray, sandy, blocky                                                                        | 16-34                  |
| Coal                                                                                                                                   | 4                      | Sandstone, blue-gray, fine-grained, hard, bedded to massive                                      | 14-24                  |
| Clay, dark gray, almost sandstone in places                                                                                            | 1                      | Clay, gray, iron-stained on fracture surfaces shaly, sandy                                       | 2 6                    |
| Shale, black, soft                                                                                                                     | 6                      | Heron (?) Coal                                                                                   | 3-4                    |
| Colchester (No. 2) Coal                                                                                                                | 2 1                    | Clay, purplish gray, sandy, blocky (sample 994B)                                                 | 4                      |
| Spoon Formation                                                                                                                        |                        | Clay, gray rusty on fracture surfaces, sandy, blocky becoming shaly near base (sample 994B)      | 2 2                    |
| Clay, gray with iron stains, noncalcareous, massive (sample 1067D) (exposed)                                                           | 2                      |                                                                                                  |                        |
| CASS COUNTY                                                                                                                            |                        |                                                                                                  |                        |
| Samples 994B, C, and D - Tributary along east bluff to Illinois River NE $\frac{1}{4}$ sec. 15, T. 18 N., R. 11 W.                     |                        |                                                                                                  |                        |
| Pleistocene Series                                                                                                                     |                        |                                                                                                  |                        |
| Glacial till and loess                                                                                                                 | 80-100                 |                                                                                                  |                        |
| Pennsylvanian System                                                                                                                   |                        |                                                                                                  |                        |
| Carbondale Formation                                                                                                                   |                        |                                                                                                  |                        |
| Sandstone (Pleasantview), gray, iron-stained on surface, shaly at top 15-20 feet, remainder massive, carbonaceous, and coaly at bottom | 35                     |                                                                                                  |                        |



| (CASS COUNTY Cont.)                                                                                                         | Thickness<br>(Ft. In.) |                                                                                                                                                 | Thickness<br>(Ft. In.) |
|-----------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Shale, gray, thinly bedded                                                                                                  | 1                      | Pennsylvanian System                                                                                                                            |                        |
| Limestone (Seville), dark blue-gray, pyritic                                                                                | 1-2                    | Carbondale Formation                                                                                                                            |                        |
| Shale, dark blue-gray, well bedded, sandy, contains concretions                                                             | 1 6                    | Shale, gray                                                                                                                                     | 10±                    |
|                                                                                                                             |                        | Shale, black, fissile                                                                                                                           | 1 6                    |
|                                                                                                                             |                        | Colchester (No. 2) Coal                                                                                                                         | 2                      |
|                                                                                                                             |                        | Spoon Formation                                                                                                                                 |                        |
|                                                                                                                             |                        | Covered interval                                                                                                                                | 2                      |
|                                                                                                                             |                        | Clay, gray (sample 958H)                                                                                                                        | 4                      |
|                                                                                                                             |                        | Limestone, blue-gray (in creek bed)                                                                                                             |                        |
| GALLATIN COUNTY                                                                                                             |                        | Sample 958K - N line of NE $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 28, T. 12 N., R. 11 W.                                          |                        |
| Sample 1809 - Outcrop south side of road in NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 19, T. 10 S., R. 8 E.   |                        | Pleistocene Series                                                                                                                              |                        |
| Pleistocene Series                                                                                                          |                        | Alluvium                                                                                                                                        | 2-3                    |
| Soil                                                                                                                        | 10±                    | Pennsylvanian System                                                                                                                            |                        |
| Pennsylvanian System                                                                                                        |                        | Spoon Formation                                                                                                                                 |                        |
| Carbondale Formation                                                                                                        |                        | Limestone (Seahorne), blue-gray                                                                                                                 | 1 6                    |
| Rocks undifferentiated                                                                                                      | 10-30                  | Clay, gray (sample 958K)                                                                                                                        |                        |
| Colchester (No. 2) Coal                                                                                                     | 4                      | (exposed)                                                                                                                                       | 1                      |
| Spoon Formation                                                                                                             |                        |                                                                                                                                                 |                        |
| Underclay, gray, (sample 1809)                                                                                              | 5                      |                                                                                                                                                 |                        |
| Shale                                                                                                                       |                        |                                                                                                                                                 |                        |
| Sample 1810 - SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 19, T. 10 S., R. 8 E.                                 |                        | Sample 958U - Abandoned underground mine south of road in center NE $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$ sec. 31, T. 12 N., R. 11 W. |                        |
| Pleistocene Series                                                                                                          |                        | Pleistocene Series                                                                                                                              |                        |
| Soil                                                                                                                        | 10±                    | Till reported by owner                                                                                                                          | 45                     |
| Pennsylvanian System                                                                                                        |                        | Pennsylvanian System                                                                                                                            |                        |
| Carbondale and Spoon Formations                                                                                             |                        | Spoon Formation                                                                                                                                 |                        |
| Rocks undifferentiated                                                                                                      | 50-70                  | Clay, gray (sample 958U)                                                                                                                        | 6                      |
| Dekoven Coal                                                                                                                | 2 6                    |                                                                                                                                                 |                        |
| Underclay, gray                                                                                                             | 2                      | Samples 958W, X, Y - South cutbank of creek, NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 12, T. 10 N., R. 12 W.                                      |                        |
| Shale, dark gray, micaceous                                                                                                 | 2                      | Pleistocene Series                                                                                                                              |                        |
|                                                                                                                             |                        | Drift                                                                                                                                           | 15                     |
|                                                                                                                             |                        | Pennsylvanian System                                                                                                                            |                        |
| GREENE COUNTY                                                                                                               |                        | Carbondale Formation                                                                                                                            |                        |
| Sample 958 F - South cutbank of Birch Creek, NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 25, T. 12 N., R. 11 W. |                        | Shale, blue-gray                                                                                                                                | 5 2                    |
| Pennsylvanian System                                                                                                        |                        | Colchester (No. 2) Coal                                                                                                                         | 1                      |
| Carbondale Formation                                                                                                        |                        | Spoon Formation                                                                                                                                 |                        |
| Sandstone (Pleasantview), upper part shaly, lower part massive and cross bedded                                             | 16-18                  | Clay, gray, sample 958W top 3 $\frac{1}{2}$ feet; 958X middle 5 feet; 958Y bottom 5 feet)                                                       | 13 6                   |
| Pyrite zone                                                                                                                 | 0- $\frac{1}{2}$       |                                                                                                                                                 |                        |
| Shale, blue-gray, thin-bedded, noncalcareous                                                                                | 6-30                   | Mississippian System                                                                                                                            |                        |
| Shale, black, soft, noncalcareous                                                                                           | 3                      | Shale, red                                                                                                                                      | 6                      |
| Shale, black, hard, fissile                                                                                                 | 1 5                    | Shale, blue                                                                                                                                     | 9                      |
| Colchester (No. 2) Coal                                                                                                     | 2 8                    | Sandstone                                                                                                                                       | 4                      |
| Spoon Formation                                                                                                             |                        | Shale, gray (exposed)                                                                                                                           | 5 $\frac{1}{2}$        |
| Clay, dark gray, noncalcareous                                                                                              | $\frac{1}{2}$ -1       | Sample 958Z - South of center NW $\frac{1}{4}$ sec. 12, T. 10 N., R. 12 W.                                                                      |                        |
| Clay, gray, noncalcareous (Sample 958F) (exposed)                                                                           | 1                      | Pleistocene Series                                                                                                                              |                        |
| Sample 958H - NW cor. SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 28, T. 12 N., R. 11 W.                                         |                        | Drift                                                                                                                                           | 10±                    |
| Pleistocene Series                                                                                                          |                        | Pennsylvanian System                                                                                                                            |                        |
| Drift                                                                                                                       | 5±                     | Carbondale Formation                                                                                                                            |                        |
|                                                                                                                             |                        | Shale, gray                                                                                                                                     | 11                     |
|                                                                                                                             |                        | Colchester (No. 2) Coal                                                                                                                         | 1 9                    |
|                                                                                                                             |                        | Spoon Formation                                                                                                                                 |                        |
|                                                                                                                             |                        | Clay, gray (sample 958Z) (exposed)                                                                                                              | 6                      |

(GREENE COUNTY Cont.) Thickness  
(Ft. In.)Thickness  
(Ft. In.)Sample 958V - Outcrop on west side of creek  
south of road, center NW $\frac{1}{4}$  NE $\frac{1}{4}$  sec. 12, T. 10  
N., R. 12 W.

Pleistocene Series

Drift 20±

Pennsylvanian System

Spoon Formation

Clay, gray (sample 958V)  
(exposed)

4-6

Sample 958BB - Outcrop in center of NW $\frac{1}{4}$  sec. 23,  
T. 12 N., R. 11 W.

Pennsylvanian System

Carbondale Formation

Pleasantview Sandstone 25±

Coaly layer 3

Shale, black, fissile 2 6

Coaly layer 1

Limestone 5

Colchester (No. 2) Coal 2 2

Spoon Formation

Clay, gray (sample 958BB)  
(exposed)

2±

Sample 958VV - Along Sand Creek about 500 yards  
west of road, SW $\frac{1}{4}$  SW $\frac{1}{4}$  sec. 30, T. 10 N.,  
R. 11 W.

Pennsylvanian System

Spoon Formation

Clay, gray (sample 958VV)  
(exposed)

5

Sample 958FFF - Outcrop along creek, NE $\frac{1}{4}$  SE $\frac{1}{4}$   
sec. 11, T. 10 N., R. 12 W.

Pleistocene Series

Drift 20-40

Pennsylvanian System

Carbondale Formation

Shale, black, fissile 6

Colchester (No. 2) Coal 1 9

Spoon Formation

Clay, gray (sample 958FFF)

5±

Geodes, clayey matrix 6-12

Sample 955 - Shale pit and in creek close by in  
SW $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 29, T. 12 N., R. 11 W.

Pleistocene Series

Silt 10

Pennsylvanian System

Carbondale Formation

Shale, blue-gray, silty 15

Colchester (No. 2) Coal 2 6

Spoon Formation

Clay, gray (sample 955) 6

Mississippian System

Limestone exposed in creek bed

Samples 956 and 957 - Clay pit, NE $\frac{1}{4}$  SW $\frac{1}{4}$  sec. 18,  
T. 12 N., R. 10 W. along Marks Creek

Pleistocene Series

Loess 10

Pennsylvanian System

Spoon Formation

Clay, gray (sample 956 upper 10  
5 feet; sample 957 lower 5  
feet)

## JACKSON COUNTY

Sample 1800 - Outcrop in bluff south of rail-  
road, SW $\frac{1}{4}$  SW $\frac{1}{4}$  NE $\frac{1}{4}$  sec. 9, T. 9 S., R. 2 W.

Pleistocene Series

Loess 15-20

Pennsylvanian System

Spoon or Abbott Formation

Coal (exposed) 6

Clay, gray, contains root  
traces (sample 1800)

3

Shale, tan 2-3

Coal 1±

Shale, tan 10

Sample 1801 - Abandoned strip coal mine west  
of Sycamore Creek, SE $\frac{1}{4}$  NE $\frac{1}{4}$  SW $\frac{1}{4}$  sec. 36, T.  
9 S., R. 1 W.

Pennsylvanian System

Spoon Formation

Vergennes Sandstone 20

Coal 4

Shale, light gray, silty 4

Coal 3 6

Clay, gray (sample 1801)

Shale, dark gray to black,  
slickensides at top,

contains ironstone nodules 6

Coal 4

Clay, gray 2

Ironstone nodule layer 6

Clay, gray (exposed) 1

Sample 1806 - West side of abandoned clay pit,  
SE $\frac{1}{4}$  SW $\frac{1}{4}$  SE $\frac{1}{4}$  sec. 29, T. 8 S., R. 2 W.

Pleistocene Series

Loess 10

Pennsylvanian System

Spoon Formation

Shale, gray 10

Murphysboro Coal 2

Abbott Formation

Clay, gray (sample 1806) 3

Shale, light gray 3

## JERSEY COUNTY

Sample 959E - South side of west tributary to  
large tributary to Piasa Creek, N $\frac{1}{2}$  SE $\frac{1}{4}$  SW $\frac{1}{4}$   
sec. 17, T. 7 N., R. 10 W.

Pleistocene Series

Drift 30±

| (JERSEY COUNTY Cont.)                                                                               |  | Thickness<br>(Ft. In.) |                                                                                                                                  | Thickness<br>(Ft. In.) |
|-----------------------------------------------------------------------------------------------------|--|------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Pennsylvanian System                                                                                |  |                        | Limestone (Seahorne), blue-gray                                                                                                  | 1½-5                   |
| Spoon Formation                                                                                     |  |                        | Clay, gray, iron-stained (sample 960E)                                                                                           | 2 6                    |
| Clay, yellowish gray (sample 959E) (exposed)                                                        |  |                        | 7                                                                                                                                |                        |
| Sample 959F - Exposed in road and west side of ditch, NE¼ NE¼ NW¼ sec. 20, T. 7 N., R. 10 W.        |  |                        | Clay, dark gray, equivalent to coal member (sample 960E)                                                                         | 6                      |
| Pleistocene Series                                                                                  |  |                        | 30-40                                                                                                                            |                        |
| Pennsylvanian System                                                                                |  |                        | Clay, gray, iron-stained, (sample 960F) (exposed)                                                                                | 3                      |
| Spoon Formation                                                                                     |  |                        | MONROE COUNTY                                                                                                                    |                        |
| Clay, gray, iron-stained (sample 959F) (exposed)                                                    |  |                        | 5 6                                                                                                                              |                        |
| Sample 959G - In west ravine south of house, SE¼ NE¼ NW¼ sec. 20, T. 7 N., R. 10 W.                 |  |                        | Sample 1797 - 200 yards from road up Andys Run at waterfall near junction of tributaries, SW¼ NE¼ NW¼ sec. 15, T. 2 S., R. 10 W. |                        |
| Pleistocene Series                                                                                  |  |                        | 30±                                                                                                                              |                        |
| Pennsylvanian System                                                                                |  |                        | Mississippian (?) System                                                                                                         |                        |
| Spoon Formation                                                                                     |  |                        | Sandstone, forms waterfall                                                                                                       | 5±                     |
| Clay, light gray, red and yellow stained, sandy (sample 959G) (exposed)                             |  |                        | Clay, gray, green, maroon (sample 1797)                                                                                          | 5±                     |
| 2 6                                                                                                 |  |                        | Sandstone (covered)                                                                                                              |                        |
| JOHNSON COUNTY                                                                                      |  |                        | Samples 1798 and 1799 - South side of road, NW¼ NE¼ SW¼ sec. 26, T. 2 S., R. 10 W.                                               |                        |
| Sample 1807 - Stream in NW¼ SE¼ NE¼ sec. 8, T. 11 S., R. 4 E.                                       |  |                        | Pleistocene Series                                                                                                               | 6                      |
| Pleistocene Series                                                                                  |  |                        | Loess                                                                                                                            |                        |
| Alluvium                                                                                            |  |                        | 10                                                                                                                               |                        |
| Pennsylvanian System                                                                                |  |                        | Mississippian (?) System                                                                                                         |                        |
| Spoon Formation                                                                                     |  |                        | Sandstone                                                                                                                        | 8                      |
| Sandstone                                                                                           |  |                        | Clay, purple and tan, shaly toward top (sample 1798)                                                                             | 3 4                    |
| Bidwell Coal                                                                                        |  |                        | 0-½                                                                                                                              | 6                      |
| Clay, shaly (sample 1807)                                                                           |  |                        | 2 6                                                                                                                              |                        |
| MADISON COUNTY                                                                                      |  |                        | Clay, purple and tan (sample 1799)                                                                                               | 3 3                    |
| Sample 393 - Underground mine, SE¼ SE¼ sec. 35, T. 6 N., R. 10 W.                                   |  |                        | PIKE COUNTY                                                                                                                      |                        |
| Pennsylvanian System                                                                                |  |                        | Samples G17, G18, G19, and G20 - Outbank south of tributary to branch of Kiser Creek, SE¼ SE¼ SW¼ sec. 25, T. 4 S., R. 5 W.      |                        |
| Spoon Formation                                                                                     |  |                        | Pleistocene Series                                                                                                               |                        |
| Seahorne Limestone                                                                                  |  |                        | 3±                                                                                                                               |                        |
| Clay, gray, silty (sample 393)                                                                      |  |                        | 4                                                                                                                                |                        |
| Clay (floor of mine)                                                                                |  |                        |                                                                                                                                  |                        |
| Samples 960C, D, E, and F - South cutbank of East Wood River, NE¼ NW¼ NW¼ sec. 15, T. 5 N., R. 9 W. |  |                        | Soil                                                                                                                             | 2                      |
| Pleistocene Series                                                                                  |  |                        | Pennsylvanian System                                                                                                             |                        |
| Drift                                                                                               |  |                        | 20±                                                                                                                              |                        |
| Pennsylvanian System                                                                                |  |                        | Spoon Formation                                                                                                                  |                        |
| Carbondale Formation                                                                                |  |                        | Clay, gray (sample G20)                                                                                                          | 3 2                    |
| Shale (Purington), gray, well bedded                                                                |  |                        | 20                                                                                                                               |                        |
| Shale, black, fissile                                                                               |  |                        | 1                                                                                                                                |                        |
| Colchester (No. 2) Coal                                                                             |  |                        | 2 6                                                                                                                              |                        |
| Spoon Formation                                                                                     |  |                        | Clay, dark gray, with 2-inch shaly zone near top                                                                                 | 1                      |
| Clay, gray, iron-stained, (sample 960C)                                                             |  |                        | 1 3                                                                                                                              |                        |
| Clay, gray, (sample 960D)                                                                           |  |                        | 1 3                                                                                                                              |                        |
| Clay, gray, iron-stained                                                                            |  |                        | 6                                                                                                                                |                        |
|                                                                                                     |  |                        | Clay, gray, iron-stained, hard and gritty (sample G19)                                                                           | 2½                     |
|                                                                                                     |  |                        | Clay, purplish gray, hard, gritty (sample G18)                                                                                   | 1                      |
|                                                                                                     |  |                        | Clay, light gray with yellow sandy masses throughout (sample G17)                                                                | 2                      |
|                                                                                                     |  |                        | Covered interval                                                                                                                 | 1 3                    |
|                                                                                                     |  |                        | Sandstone, yellowish gray, clayey                                                                                                | 8                      |
|                                                                                                     |  |                        | Shale, sandy (exposed)                                                                                                           | 5                      |
|                                                                                                     |  |                        | Samples 996B-C, D, and E - Outcrop in east bank of creek south of road, NW¼ NW¼ sec. 26, T. 4 S., R. 5 W.                        |                        |
|                                                                                                     |  |                        | Pleistocene Series                                                                                                               |                        |
|                                                                                                     |  |                        | Loess                                                                                                                            | 6-12                   |

## (PIKE COUNTY Cont.)

Thickness  
(Ft. In.)Thickness  
(Ft. In.)

## Pennsylvanian System

## Spoon or Abbott Formation

|                                               |   |   |
|-----------------------------------------------|---|---|
| Sandstone, gray                               | 1 |   |
| Clay, gray, very sandy<br>(sample 996E)       | 4 | 6 |
| Clay, dark gray (sample 996D)                 | 5 |   |
| Sandstone layer                               |   | 9 |
| Shale, gray, hard, flinty<br>(samples 996B-C) | 4 |   |

Sample 996N - Outcrop in ditch along north-south road, NW $\frac{1}{4}$  SW $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 10, T. 4 S., R. 5 W.

## Pleistocene Series

Soil 2

## Pennsylvanian System

## Spoon or Abbott Formation

Clay, gray, sandy near base  
(sample 996N) 8

## Mississippian System

Limestone 20

Sample 996F - Outcrop west side of roadcut, NE $\frac{1}{4}$  NE $\frac{1}{4}$  NE $\frac{1}{4}$  sec. 4, T. 4 S., R. 5 W.

## Pleistocene Series

Loess 20±

## Pennsylvanian System

## Spoon or Abbott Formation

Clay, gray (sample 996F)  
(exposed) 6

Sample 1719 - Outcrop in east bank of Prairie du Pont Creek 150 yards southwest of bridge, SW $\frac{1}{4}$  NW $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 34, T. 1 N., R. 9 W.

## Pennsylvanian System

## Carbondale Formation

|                                                                  |      |   |
|------------------------------------------------------------------|------|---|
| Shale, red to purple                                             | 5-10 |   |
| Sandstone, gray, thinly bedded, micaceous with thin silty layers | 15   |   |
| Shale, black                                                     | 1    | 5 |
| Colchester (No. 2) Coal                                          | 2    |   |

## Spoon Formation

|                          |     |  |
|--------------------------|-----|--|
| Clay, gray (sample 1719) | 3   |  |
| Siltstone, light gray    | 2-3 |  |
| Sandstone at creek level |     |  |

## SALINE COUNTY

Sample 1804 - High wall of coal strip pit, NW $\frac{1}{4}$  NE $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 26, T. 10 S., R. 7 E.

## Pennsylvanian System

## Carbondale Formation

|                         |     |   |
|-------------------------|-----|---|
| Sandstone               | 20± |   |
| Shale, gray             | 20± |   |
| Shale, black            | 1   | 6 |
| Colchester (No. 2) Coal |     | 7 |

## Spoon Formation

|                                    |       |  |
|------------------------------------|-------|--|
| Clay, gray (sample 1804)           | 5     |  |
| Shale, gray                        | 20-30 |  |
| DeKoven Coal                       | 2½-3  |  |
| Clay, gray, micaceous<br>(exposed) | 1     |  |

Sample 1805 - Old coal strip pit on north side of road, SW $\frac{1}{4}$  SW $\frac{1}{4}$  SE $\frac{1}{4}$  sec. 23, T. 9 S., R. 7 E.

## Pennsylvanian System

## Spoon Formation

|                                     |     |  |
|-------------------------------------|-----|--|
| Sandstone and shale                 | 50± |  |
| Shale, black, ironstone concretions | 2   |  |
| DeKoven Coal                        | 4   |  |
| Clay, gray, shaly<br>(sample 1805)  | 3   |  |
| Shale                               | 10  |  |
| Sandstone                           | 3   |  |

Sample 1808 - Outcrop along north side of east-west road, NE $\frac{1}{4}$  NW $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 25, T. 10 S., R. 7 E.

## Pleistocene Series

Loess and till 15

## Pennsylvanian System

## Spoon Formation

|                                                                    |   |   |
|--------------------------------------------------------------------|---|---|
| Sandstone, thinly bedded                                           | 2 |   |
| Shale, sandy                                                       | 5 |   |
| Sandstone                                                          | 2 |   |
| Shale, sandy                                                       | 1 |   |
| Coal                                                               |   | 4 |
| Clay, gray, greenish toward base, shaly<br>(sample 1808) (exposed) | 3 | 6 |

Samples 1811 and 1812 - High wall of coal strip pit, center of sec. 4, T. 10 S., R. 7 E.

## Pennsylvanian System

## Spoon Formation

|                                        |    |   |
|----------------------------------------|----|---|
| Palzo Sandstone                        | 15 |   |
| Shale                                  | 30 |   |
| DeKoven Coal                           | 3  |   |
| Clay, gray, micaceous<br>(sample 1811) | 2  | 4 |
| Siltstone, sandy                       | 12 |   |
| Shale, black                           | 3  |   |
| Davis Coal                             | 4  | 5 |
| Clay, gray (sample 1812)<br>(exposed)  |    | 6 |

Sample 1813 - High wall of coal strip pit, SE $\frac{1}{4}$  NE $\frac{1}{4}$  SW $\frac{1}{4}$  sec. 5, T. 10 S., R. 7 E.

## Pennsylvanian System

## Carbondale Formation

|                         |    |   |
|-------------------------|----|---|
| Sandstone and shale     | 15 |   |
| Shale, coaly            |    | 6 |
| Shale, dark gray        |    | 5 |
| Colchester (No. 2) Coal |    | 4 |

## Spoon Formation

|                                          |    |  |
|------------------------------------------|----|--|
| Clay, gray, root traces<br>(sample 1813) | 6  |  |
| Palzo Sandstone                          | 15 |  |

Sample 1814 - Outcrop east of Battle Ford Creek, NW $\frac{1}{4}$  SE $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 21, T. 10 S., R. 6 E.

## Pennsylvanian System

## Spoon Formation

| (SALINE COUNTY Cont.)                                                                                                          |     | Thickness<br>(Ft. In.) |                                                                                                                                                       | Thickness<br>(Ft. In.) |
|--------------------------------------------------------------------------------------------------------------------------------|-----|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| Sandstone and shale                                                                                                            |     | 15                     | Spoon Formation                                                                                                                                       |                        |
| Mt. Rorah Coal                                                                                                                 |     | 1 5                    | Clay                                                                                                                                                  | 2-3                    |
| Clay, gray, slightly shaly (sample 1814)                                                                                       |     | 3                      | Seahorne Limestone                                                                                                                                    | 1-3                    |
| Sandstone                                                                                                                      |     |                        | Covered interval                                                                                                                                      | 2                      |
|                                                                                                                                |     |                        | Clay (sample 995A) (exposed)                                                                                                                          | 6                      |
| Sample 1815 - Outcrop west of Battle Ford Creek, NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 20, T. 10 S., R. 6 E. |     |                        | Sample 995B - Along stream east of road in NW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 14, T. 13 N., R. 12 W.                                              |                        |
| Pennsylvanian System                                                                                                           |     |                        | Pleistocene Series                                                                                                                                    |                        |
| Spoon Formation                                                                                                                |     |                        | Drift                                                                                                                                                 | not measured           |
| Sandstone, shaly at base                                                                                                       | 20  |                        | Pennsylvanian System                                                                                                                                  |                        |
| Shale, black, highly organic                                                                                                   |     | 2                      | Carbondale Formation                                                                                                                                  |                        |
| Shale, brown                                                                                                                   | 1   |                        | Pleasantview Sandstone                                                                                                                                | 50                     |
| Clay, shaly (sample 1815) (exposed)                                                                                            |     | 3                      | Shale, dark gray to black, soft                                                                                                                       | 1                      |
| Sample 1816 - Abandoned coal strip pit, SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 21, T. 10 S., R. 5 E.          |     |                        | Shale, black, fissile                                                                                                                                 | 2 6                    |
| Pleistocene Series                                                                                                             |     |                        | Covered interval                                                                                                                                      | 5                      |
| Loess                                                                                                                          | 10  |                        | Spoon Formation                                                                                                                                       |                        |
| Pennsylvanian System                                                                                                           |     |                        | Limestone (Seahorne), blue-gray, knobby                                                                                                               | 4                      |
| Carbondale Formation                                                                                                           |     |                        | Clay, gray, red-stained (sample 995B)                                                                                                                 | 6                      |
| Shale, black                                                                                                                   | 5   |                        | Clay, gray (sample 995B) (exposed)                                                                                                                    | 2                      |
| Colchester (No. 2) Coal                                                                                                        |     | 9                      | Sample 995H - High cutbank east side of ravine in SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 23, T. 15 N., R. 13 W.                      |                        |
| Spoon Formation                                                                                                                |     |                        | Pleistocene Series                                                                                                                                    |                        |
| Shale, dark gray to black                                                                                                      | 1 6 |                        | Loess and till                                                                                                                                        | 10-15                  |
| Clay, gray, greenish toward base (sample 1816)                                                                                 |     | 3 6                    | Pennsylvanian System                                                                                                                                  |                        |
| Shale                                                                                                                          |     |                        | Spoon Formation                                                                                                                                       |                        |
| Sample 1817 - Old coal strip pit SW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 21, T. 10 S., R. 5 E.                 |     |                        | Limestone (Seahorne), gray, knobby                                                                                                                    | 4                      |
| Pennsylvanian System                                                                                                           |     |                        | Clay, gray, rusty (sample 995H)                                                                                                                       | 5                      |
| Spoon Formation                                                                                                                |     |                        | Clay, dark gray, coal horizon, gypsum                                                                                                                 | 1                      |
| Rocks, undifferentiated                                                                                                        | 25  |                        | Clay, gray, purplish at top                                                                                                                           | 6 6                    |
| Shale, black                                                                                                                   | 3   |                        | Shale, dark gray, sandy, poorly bedded, iron sulphate                                                                                                 | 2 3                    |
| DeKoven Coal                                                                                                                   | 3   |                        | Abbott Formation                                                                                                                                      |                        |
| Clay, gray (sample 1817)                                                                                                       | 2 8 |                        | Sandstone, bluish gray, fairly coarse-grained, shaly, plant impressions                                                                               | 0-10                   |
| Sandstone (exposed)                                                                                                            | 4   |                        |                                                                                                                                                       |                        |
| Sample 1821 - Along roadcut on section line in NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 23, T. 10 S., R. 5 E.   |     |                        |                                                                                                                                                       |                        |
| Pennsylvanian System                                                                                                           |     |                        |                                                                                                                                                       |                        |
| Spoon Formation                                                                                                                |     |                        |                                                                                                                                                       |                        |
| Sandstone                                                                                                                      | 15  |                        |                                                                                                                                                       |                        |
| Shale, black                                                                                                                   | 2   |                        |                                                                                                                                                       |                        |
| Clay (sample 1821)                                                                                                             | 8   |                        |                                                                                                                                                       |                        |
| Coal                                                                                                                           | 2   |                        |                                                                                                                                                       |                        |
| Clay (covered)                                                                                                                 |     |                        |                                                                                                                                                       |                        |
|                                                                                                                                |     |                        |                                                                                                                                                       |                        |
| SCOTT COUNTY                                                                                                                   |     |                        | WILLIAMSON COUNTY                                                                                                                                     |                        |
| Sample 995A - Along ravine in E $\frac{1}{2}$ NE $\frac{1}{4}$ sec. 14, T. 13 N., R. 12 W.                                     |     |                        | Sample 1802 - Near top of east end of old quarry east of Creal Springs, SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 25, T. 10 S., R. 3 E. |                        |
| Pennsylvanian System                                                                                                           |     |                        | Pennsylvanian System                                                                                                                                  |                        |
| Carbondale Formation                                                                                                           |     |                        | Spoon Formation                                                                                                                                       |                        |
| Pleasantview Sandstone                                                                                                         | 5   |                        | Sandstone                                                                                                                                             | 3                      |
| Shale, black, soft, ferrous sulphate stained                                                                                   | 1 2 |                        | Shale, gray                                                                                                                                           | 10                     |
| Shale, black, fissile                                                                                                          | 2 9 |                        | Mt. Rorah Coal                                                                                                                                        |                        |
| Colchester (No. 2) Coal                                                                                                        | 2 7 |                        | Coal                                                                                                                                                  | 1 4                    |
|                                                                                                                                |     |                        | Clay, shaly                                                                                                                                           | 9                      |
|                                                                                                                                |     |                        | Coal                                                                                                                                                  | 5                      |

(WILLIAMSON COUNTY Cont.) Thickness  
(Ft. In.)

|                         |    |   |
|-------------------------|----|---|
| Clay (sample 1802)      | 5  |   |
| Siltstone               | 1  |   |
| Shale, gray             | 5  |   |
| Creal Springs Limestone | 1  | 6 |
| Shale, gray             | 5  |   |
| Granger Sandstone       | 40 |   |

Sample 1803 - East side of road south of Palzo,  
NW $\frac{1}{4}$  SW $\frac{1}{4}$  NW $\frac{1}{4}$  sec. 22, T. 10 S., R. 4 E.

## Pennsylvanian System

|                                                     |   |   |
|-----------------------------------------------------|---|---|
| Spoon Formation                                     |   |   |
| Palzo Sandstone                                     | 6 |   |
| Shale, black                                        | 2 |   |
| Clay, shaly                                         | 6 |   |
| Clay, gray, pale green<br>toward base (sample 1803) | 3 |   |
| Clay, limonite                                      |   | 4 |
| Shale                                               | 5 |   |

Samples 1818, 1819, and 1820 - West side of road  
at the NW edge of Stonefort, SW $\frac{1}{4}$  NE $\frac{1}{4}$  SE $\frac{1}{4}$   
sec. 25, T. 10 S., R. 4 E.

## Pennsylvanian System

|                                                   |                   |   |
|---------------------------------------------------|-------------------|---|
| Spoon Formation                                   |                   |   |
| Sandstone and covered<br>intervals                | 40                |   |
| Shale, black                                      | 4-5               |   |
| Clay (sample 1820)                                | 4                 |   |
| Coal                                              |                   | 2 |
| Clay, gray to pale green<br>at base (sample 1819) | 5                 | 6 |
| Shale, black                                      | 1-1 $\frac{1}{2}$ |   |
| Shale, sandy                                      | 7                 | 6 |
| Shale                                             | 3                 |   |
| Clay, greenish gray<br>(sample 1818)              | 3                 |   |
| Shale                                             |                   |   |

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